to as confirming the view that the present form of the island has only been acquired recently.

The useful minerals are described in Part III., and their distribution is indicated on the map already referred to. Of most of them Dr. Posewitz has previously published separate descriptive monographs.

The rich coal-fields are first described. The seams are exposed in many river cuttings in Sarawak and Brunei. Coal also occurs on the Island of Labuan and in Sabah. There are said to be rich and extensive deposits in East Borneo also, but they have not been worked.

Gold is of the next importance to coal as a mineral product. Mining in the older formations has hitherto not proved remunerative, the best field being from the diluvial deposits, which are worked almost exclusively by Chinese. The richest gold regions are in the south-east, near Tanah Laut and Kusan, on both sides of the auriferous Meatus Mountains; and in the north-east, in the Chinese districts of West Borneo and Sarawak. Recently, what promise to be rich gold deposits have been discovered in the Upper Segamah River in Sabah.

The production of gold was much more considerable formerly than it is at present. In West Borneo it amounts annually to 120,000–150,000 kilogrammes, and in Sarawak it amounted to 28,281 kilogrammes in 1886.

Diamonds are not, comparatively speaking, so abundant as gold, but they occur in the same deposits. They are searched for by Chinese. Since the introduction of the cheaper Cape diamonds, the production has fallen. In 1884, 2727 carats were exported from West Borneo, and 1200 carats from Sarawak in 1886.

Dr. Posewitz refers to the late Prof. Lewis's speculation as to the connection between diamonds and serpentine (*Peridotite*) (NATURE, vol. xxxvi. p. 571), but states that it is not yet known how far his conclusion is correct, that diamonds and platinum are only found in Borneo in streams which traverse areas containing serpentine. Indeed, it may be added that serpentine is of rare occurrence in the principal diamond regions of India, and in some of them none whatever has been observed.

The famous "diamond" of 367 carats, known as the "Matan," from the territorial title of the Rajah to whom it belongs, has been estimated to be worth £269,378 (Crawfurd). The Dutch made very large offers of money and warlike material for it early in the present century, but these were always refused. The stone, it now appears, was examined in 1868, and proved to be only a rock crystal with a specific gravity of 2·63, thus confirming doubts perviously expressed as to its being really a diamond.

Platinum is of very local occurrence in Tanah Laut only.

Antimony and quicksilver only occur, so far as is known, in sufficient quantities to be regularly mined in Sarawak.

Iron ores are widely distributed, but are of no present economic value. The introduction of cheap European iron has put an end to the native iron industry, as is the case, too, in many parts of India.

Dr. Posewitz states that the condition of mining industries generally in Borneo is at present very poor. In the south, private coal-mines existed, but were put an end to by an insurrection. The well-known Government mines at Pengaron ceased working after thirty-six years' existence, as they were no longer remunerative. A private company has now commenced to work valuable mines on the east coast. In Sarawak, mines have been worked by the Government since 1881, and in 1886 produced 44,167 tons. In Labuan, mines were also worked for some time, but are now closed. The principal source of supply at present is from Brunei (Muara coal). It is hoped that in the British North Borneo Company's territory extensive workings of gold and coal will be established.

It is impossible to give here an adequate idea of the careful details with which each topic discussed in this work is illustrated. At the same time there is a highly meritorious conciseness of treatment which, together with the soundness of the author's views and his careful quotation of his authorities, makes the work a text-book for which it is to be hoped that a competent translator into English and an enterprising publisher will be found. It is emphatically a work which was much wanted, as our knowledge of the geology of this important island has hitherto been most fragmentary and imperfect, and we trust, therefore, that, ere long, steps may be taken to make Dr. Posewitz's labours better known to English readers.

V. B.

GRAPHICS.

Graphics; or, the Art of Calculation by drawing Lines, applied especially to Mechanical Engineering. With an Atlas of Diagrams. By Robert H. Smith, Professor of Engineering, Mason College, Birmingham. Part I. (London: Longmans, Green, and Co., 1889.)

MAXWELL was the first, according to the Introduction of the present treatise, to state the principles in a very complete and general manner by which stress-diagrams are drawn, in the *Phil. Mag.*, xxvii., 1864; and also in the Trans. Roy. Soc. Edinburgh, vol. xxvi.

But Maxwell himself is careful to point out that he derived the original idea from Mr. W. P. Taylor, or at least was unaware of his previous use of the method.

The method is of much greater antiquity, and can be traced through Moseley's "Mechanical Principles of Engineering and Architecture," 1843, to Hutton's "Course of Mathematics," 1811, and probably still further back.

It is, however, only of recent years that Maxwell's treatment has been followed up and developed by Cremona, Culmann, von Ott, and others; and now the method is considered indispensable in practice for the calculation of the stresses in bridges, roofs, and engineering and architectural structures generally.

Two great advantages of the graphic method recommend it to the practical man—the first, that the diagram is itself a check upon the correctness of its construction; and the second, that the numerical results of the diagram are read off on a scale only to the really practically significant number of figures, the very roughness and imperfection of the draughtsman's work showing the margin of variation to be allowed for.

As to the relative rapidity of the graphic method compared with ordinary numerical calculation by logarithms and arithmetical processes, the author points out that, while for a single isolated calculation the graphic method may easily be distanced, it is in the long-continued series of

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operations of the same character required by the engineer, shipbuilder, or constructor in general, that the graphic method takes the lead once the calculator has got his mental operations thought out, and his instruments in good order; for which purpose Chapter I., on instruments, gives valuable hints and information.

Chapter II. explains succinctly the plan of the book in its applications to graph-arithmetic, Chapter III.; graph-algebra, Chapter IV.; grapho-trigonometry and mensuration, Chapter V., &c., and lastly, grapho-dynamics, experimental and mathematical tabulation.

It is in the later chapters that the full power of the graphic method is developed, but in the earlier chapters the student is exercised by well-chosen practical examples in the mental operations and manipulation required in the advanced processes. The student of ordinary mathematical processes will find here graphic solutions of geometrical loci, and the solution of quadratic, cubic, and other algebraical and trigonometrical equations, illustrated by carefully-drawn diagrams in the atlas of plates. But the author appears to underrate the value of the planimeter on p. 63, in its application to the evaluation of the irregular areas encountered in indicator diagrams, shipbuilding, and railway engineering.

In Chrystal's "Algebra," the importance of the graphic solution in integers of the loci represented by indeterminate equations of the first and second degree is pointed out; and in the present work the graphic solution of the general quadratic and cubic equations by means of a carefully-drawn curve, $y = \frac{x^2}{10}$, or $y = \frac{x^3}{100}$, and its intersections with a straight line, is also developed, and illustrated in the Atlas of Diagrams.

The logarithmic curve, $y = e^x$, or 10^x, would also be useful for the graphic solution of transcendental equations of the form—

$$\mathrm{A}a^x + \mathrm{D}x + \mathrm{F} = 0,$$

required in the problem of the hydraulic buffer.

Again, in trigonometry, the solution of the equation—

$$a \cos \theta + b \sin \theta = c,$$

or the summations $\Sigma \cos (\alpha + n\beta)$ or $\Sigma' \sin (\alpha + n\beta)$ by a graphical method, or drawing Lissajous's figures graphically, would tend to impart freshness to a subject at present running in a narrow dry rut. Paper ruled into small squares of centimetres and millimetres, suitable for graphic methods, can be obtained in Germany, of Carl Schleicher and Schüll in Düren, for instance.

It is curious to notice that the fresh and original ideas and treatment of elementary mathemathical subjects due to Maxwell and Clifford are to be found embodied and adopted only in practical and technical treatises, such as the present work. Elementary mathematical treatises are in danger of becoming as dry and orthodox as a religious creed: examiners, on the one hand, are forbidden to set ideas out of the groove of a few antiquated text-books; and examinees, on the other hand, dare not allow themselves to learn new ideas and methods, for fear of finding themselves at a disadvantage with old-fashioned examiners.

Some reflections on p. 181 of the present work on the radiant-energy-carrying ether show, however, that the author allows himself occasionally to indulge in the purely abstract speculations dear to Sir W. Thomson and Mr. Macfarlane Gray.

Chapter IX., on the "Kinematics of Mechanisms," covers much the same ground as Kennedy's "Mechanics of Machinery," and follows Reauleaux's treatment in his "Kinematik." Chapter X., on "Static Structures, Frames, or Linkages," and Chapter XI., on "Flat Static Structures, containing Beam-Links," contain the applications of the graphic method to problems most commonly encountered by the practical designer.

The consideration of "Solid Static Structures" in Chapter XII. follows very usefully as a check upon the *in plano* treatment of the subject in the two preceding chapters. The failure of many very scientifically-designed bridges in America has shown that it is not sufficient to treat the beam in elevation only, as if it was a vertical plane structure; but that the torsional rigidity is of importance whenever the load is applied in the least degree eccentrically.

A glossary of special terms and symbols is inserted at the beginning, containing without redundancy the new terminology useful in this subject; and an index completes the work, in which we should like to have seen a complete list of books in English bearing on this and kindred subjects, such as Cotterill's "Applied Mechanics,' Eagles's "Constructive Geometry," Clarke's "Graphic Statics," Wormell's "Plotting, or Graphic Arithmetic"; also McLay's articles on "Geometrical Drawing," now appearing in the *Practical Engineer*.

The author promises a second part dealing with "The Distribution of Stress and Strain," "The Strength, Stiffness, and Design of Beams and Struts," "Economy of Weight in Structures," "Stresses in Redundant Structures," "Statics and Dynamics of Machines," "Frictional Efficiency," "Governors and Fly-wheels," "Valve Gears," "Practical Thermodynamics of Furnaces, Boilers, and Engines," "Hydrostatics and Hydrokinetics of Ships and Hydraulic Machines"—all subjects of great practical and theoretical interest, to which we shall look forward with much pleasure. A. G. GREENHILL.

THE CHEMICAL ANALYSIS OF IRON.

The Chemical Analysis of Iron. By Andrew Alexander Blair. (London: Whittaker and Co. Philadelphia: J. B. Lippincott, 1888.)

OF all the branches of quantitative analysis practised for the control of industrial processes, none is of greater importance than that which concerns iron. The precise relationship of chemical composition to mechanical properties is by no means fully ascertained; but a great deal of excellent work has been done in this direction, and we know in several cases the kind of variation in physical properties which is, *cæteris paribus*, to be expected to accompany a variation in the quantity of one constituent. We know, moreover, how extraordinarily great this physical change may be, compared with the change in composition. When we reflect that a quantity, which in most other technical analyses is within the error of experiment, may become the criterion by which an iron is appraised, we must recognize the necessity of accurate methods of analysis for this particular commodity.

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